Timestamp: 3/29/2016 16:46:02

Title of Proposed Observation:

Observations of Transit of Mercury (ToM) 2016 May 9

Main Objective:

Mercury will transit the Sun on 2016 May 9. We would like to use Hinode to observe the event with SOT, XRT, and EIS. The next opportunity will not be until the transit of November 2019. This HOP defines the overall plan for Hinode observations of this Transit of Mercury (ToM).

Details of the observation schedule will have to be put together by the planning team after the Hinode observation and orbit timings are better defined (e.g., twilight and/or night timings).

Scientific Justification:

Our observational objectives are multi-fold:

(a) We will study the black drop effect in white-light with SOT during contacts I and IV. A convincing explanation for this long-observed effect has been presented only recently (e.g., Schneider et al. 2004, Pasachoff et al. 2011). We will seek to gain further insight into the phenomenon with SOT images.

(b) Image in Ca II as Mercury crosses spicules (or a prominence) at the limb; this could be useful, e.g., characterizing spicule widths.

(c) Use SOT/NFI observations in the Na D1 line, to attempt to image exospheric absorption.

(d) Polarization measurements with SOT/SP to characterize the polarization state of the instrumental scattered light.

(e) Observations from XRT to observe Mercury silhouetted against the coronal background before, during, and after the transit.

(f) The above SOT and XRT images, and also EIS slot images can be taken for public outreach and media releases. The public component should complement nicely the exceptional public images from the 2012 transit of Venus.

(g) Complementary images should be obtained with IRIS slit jaw images for public outreach.

References:

Pasachoff, J. M., Schneider, G. & Widemann, T. 2011, Astron. J 2011, 141, 112
Schneider, G., Pasachoff, J. M., & Golub, L. 2004, Icarus, 168, 249

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SSC Point of Contact: Sabrina Savage (NASA/MSFC)

Dates: 09 May 2016

Time window: ~11:00 UT - 19:00 UT

Target(s) of interest:

- Prior to first contact

- 1st-2nd contacts

- During solar-disk transit (i.e., between 2rd-3th contacts)

- 3rd-4th contacts.

- After fourth contact.

SOT Requests:

FOV: 109" x 55", unbinned pixels.

Filters and Programs:

- From prior to contact I until contact II, and from contact III continuing after contact IV.

A cycle of BFI filters, including 3883.5 CN, 4504.5 blue continuum, 5550 green continuum, 6684 red continuum, and Ca II. Cadence for most of the period could be about one image per 10 s. For the time around the black-drop time (e.g, for about 2 min on either side of contacts I and IV), the cadence should be increased to as fast as possible (perhaps 1 image per 5 sec). An average "best" focus position could be used for all wavelengths.

[If FG is not available, some SP small scans (with a few-seconds cycle time) could be tried at the limb at ingress/egress. This could also be done at a few locations across the solar disk.]

- Between contacts II and III.

- A sequence of BFI and NFI images, run as a set of images, several times during the period. Cadence is not critical, but should be run as regularly as possible within the telemetry constraints.

- If possible, a sequence of polarimetric scans through the Na D1 5896 line with the NFI, to look for any detectable resonance scattering. The expected absorption in the Na D1 line will be about 0.1 Å blueward of the line core, so the passband should be tuned appropriately. Some images should also be obtained in the other line wing or in the continuum to separate out the normal darkening near the limb (due to the instrumental PSF) from the excess absorption due to the exosphere.

- Some BFI and NFI observations should be planned between 14 and 15 UT to coordinate with the DST observations; see "other participating instruments" below.

- For SOT/SP: For polarization observations: imaging in the continuum near 6302 (even across

the full 6301/6302 lines) with SOT/SP (or at a continuum wavelength with the NFI).

EIS Requests:

Slot images for public outreach movies.

XRT Requests:

From just prior to contact I until just after contact IV: A sequence of coronal observations with Mercury in the FOV, to image the planet silhouetted against the background corona. Imaging in either Al-poly, Ti-poly, C-poly, or Al-mesh is recommended.

From prior to contact I and/or after contact IV, XRT can try as-deep-as-feasible exposures to measure Mercury against the relatively smooth coronal background. A subfield with 2x2 binning could be used, images either in Al-poly, Al-mesh (with binning), Ti-poly, or C-poly.

Exposure times will be limited if active regions are present on the Sun, and in that case taking a large number of images is desired so that they can possibly be combined in post-processing. A subfield can be taken, and binning of 2x2 or even 4x4 could be used to help increase the number of images taken.

[If XRT is already in eclipse season, XRT may be restricting the use of Filter Wheel 1; this would limit the filters that XRT can use to Ti-poly and Al-mesh.]

IRIS Requests:

Proposal has not been submitted to IRIS team. Request concurrent IRIS observations.

Additional instrument coordination:

Dunn Solar Telescope (DST)

Previous HOP information:

HOPs 238 and 280:

Pasachoff, Jay M.; Dantowitz, Ronald; Voulgaris, Aristeidis 2016
American Astronomical Society, AAS Meeting #227, id.125.02
"Structure, Dynamics, and Spectra of the Solar Corona at the 2013 and 2015 Total Eclipses and Plans for 2017's American Totality"

Additional Remarks:

Dunn Solar Telescope (DST) is expected observe the Na D1 line and G-band. Sunrise at Sacramento Peak will occur after 2nd contact
and observations will begin at about 14 UT.